

# **Developing Procedures And Standards For Mobile Air Conditioning Systems**

## **Mobile Air Conditioning Summit**

**March 15 -16, 2005**

**Sacramento, California**

**Ward Atkinson**

# **Published 2005 SAE Documents**

- **J639 Safety Standards for Motor Vehicle Refrigerant Vapor Compression Systems**
- **J2064 R134a Refrigerant Automotive Air-Conditioned Hose**
- **J2670 Stability and Compatibility Criteria for Additives and Flushing Materials Intended for Use in Vehicle Air-Conditioning Systems Using R134a**

# Published 2005 SAE Documents

- **J2683 Refrigerant Purity and Container Requirements For Carbon Dioxide (CO<sub>2</sub> R-744) Used in Mobile Air-Conditioning Systems**
- **J2727 R134a Mobile Air Conditioning System Leakage Chart**

# SAE J2727

- **“System Leakage Chart” developed from**
  - **industry experience of expected refrigerant leakage gains from technology changes.**
- **Provides a rating value of technologies that are currently available.**
- **Provides information to prepare Excel file “Leakage Chart” of AC system.**

# SAE J2727

- **Not the intent to define the refrigerant emissions from a mobile air conditioning system.**
- **Basis for development of future SAE Standards for determining mobile air conditioning refrigerant emissions**

# SAE J2727

- **Identifies 6 Types of refrigerant connections**
- **Identifies 6 Types of connections for:**
  - **Service Fittings**
  - **Switches/controls**
- **Identifies 4 types of flexible hose material**
- **Identifies Type of compressor shaft and housing seals**

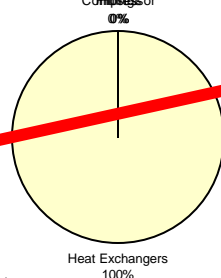


# SAE J2727 TEMPLATE

Leakage Chart							
System Component Connection							Calculated Value
<b>Fittings</b>							<b>Do Not Enter Data</b>
Rigid Pipe connections	Single O-ring	Single Captured O-ring	Multiple O-ring	Seal Washer	Seal Washer with O-ring	Metal Gasket	
<b>Total Emissions</b>	125	75	50	10	5	1	
Number of fittings:							0.000
<b>High Side service port</b>							
<b>Total Emissions</b>	60	60	40	10	5	1	
Number of fittings:							0.000
<b>Low-Side service port</b>							
<b>Total Emissions</b>	40	40	25	10	10	1	
Number of fittings:							0.000
<b>PRV, Switches, Transducers</b>							
<b>Total Emissions</b>	40	40	25	10	10	1	
Number of fittings:							0.000
						Fittings Total	0.000
			Calculated Value	Type of Hose			
<b>Flexible Hose</b>							
Includes Hose and Hose Coupling Crimps [End Connections included in Component Connection]	Length [mm]	Inner Diameter [mm]	Inner Surface Area <b>Do Not Enter Data</b>	All Rubber Hose	Standard Barrier or Veneer Hose	Ultra-low Perm Barrier or Veneer Hose	<b>Do Not Enter Data</b>
High pressure line 1			0				0.000
High pressure line 2			0				0.000
High pressure line 3			0				0.000
High pressure line 4			0				0.000
Low pressure line 1			0				0.000
Low pressure line 2			0				0.000
Low pressure line 3			0				0.000
Low pressure line 4			0				0.000
TOTAL	[place hose size in appropriate]			[place a "1" in the appropriate cell]		Hose Total	0.000
<b>Heat Exchangers other Components</b>							
Assumption = 0.001						Heat Exchange Total	0.001
This includes muffler, receiver/drier, accumulator components	[heat exchanger value pre-set value 1]				[heat exchanger value pre-set value 1]		
<b>Compressor</b>							
	Type of seal						
	Single Lip+ Body O-rings	Single Lip+Body Gaskets	Multiple Lip and Body O-rings	Multiple Lip + Gaskets			<b>Do Not Enter Data</b>
<b>Total Emissions</b>	2500	2000	1200	700			
Compressor						Compressor Total	0.000
	[place a "1" in the appropriate cell]						

Summary	% Contribution
Fittings	0.0%
Hoses	0.0%
Heat Exchangers	100.0%
Compressor	0.0%
	100.0%
<b>Rating Value</b>	<b>0.0</b>
> 1 - Leakage Enhancement Level IV 2 - Leakage Enhancement Level III 3 - Leakage Enhancement Level II 4 - Leakage Enhancement Level I < 5 - Standard leakage	

% System Component Contribution



Fittings

Service Ports  
Switches

Flexible  
Hoses

Heat  
Exchangers

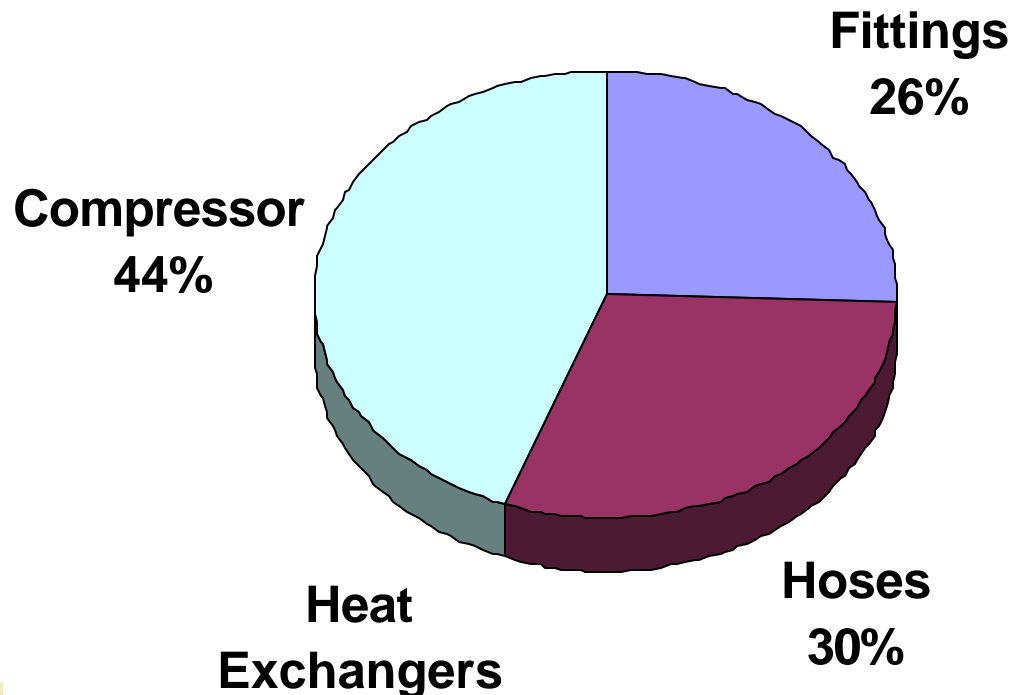
Compressor

Total Rating

# Average System Rating

**5.6**

**% System Component Contribution**





# Hose Material Change

- **Change High Pressure Hose**
  - From: Veneer
  - To: Ultra-low Perm
- **Change Low Pressure Hose**
  - From: Rubber
  - To: Veneer

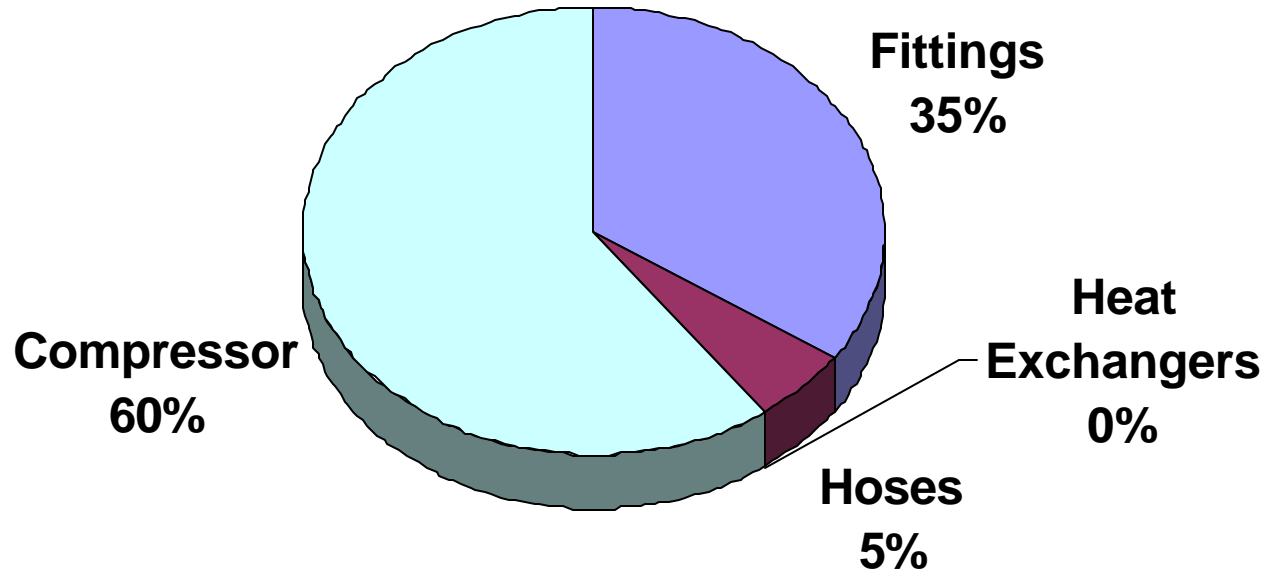
One  
level  
change

Flexible Hose			Type of Hose		
Includes Hose and Hose Coupling Crimps [End Connections included in Component Connection]	Length [mm]	Inner Diameter [mm]	All Rubber Hose	Standard Barrier or Veneer Hose	Ultra-low Perm Barrier or Veneer Hose
High pressure line 1	650	10		1	1
High pressure line 2					
High pressure line 3					
High pressure line 4					
Low pressure line 1	650	16	1	1	
Low pressure line 2					9
Low pressure line 3					
Low pressure line 4					

# New System Rating

**4.2**

**% System Component Contribution**



# Compressor Seal Change

- **Changing Compressor** (Includes hose)
  - Housing Seal From O-ring To Body Seal
- **Provides additional reduced system emissions**

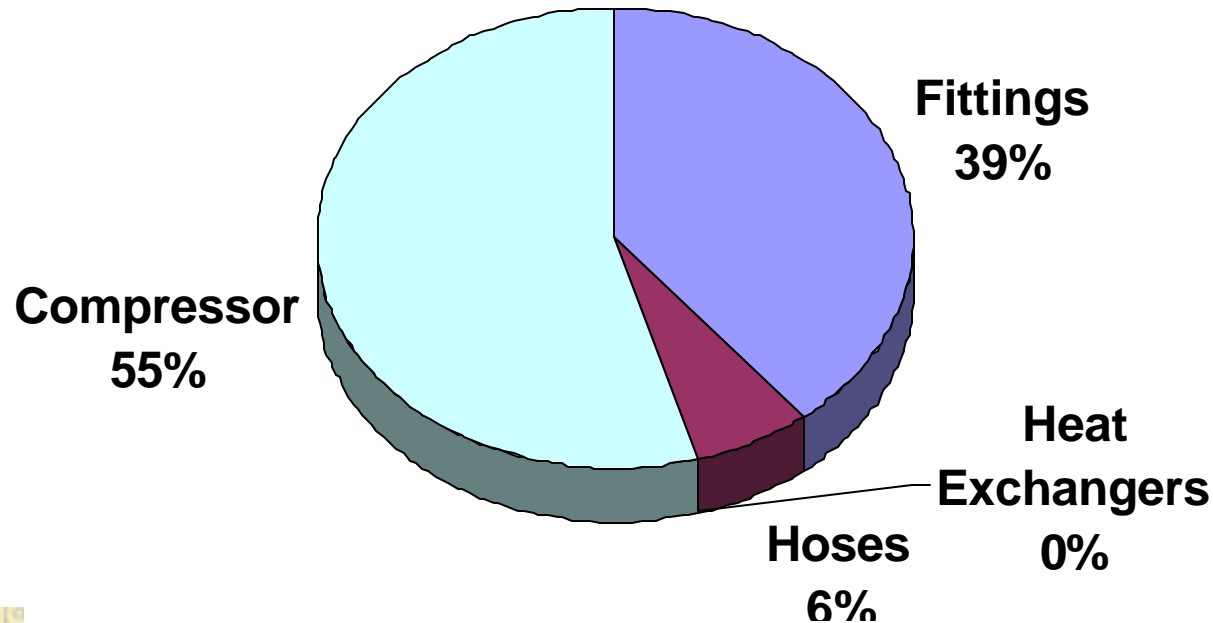
One level change

	Single Lip+ Body O-rings	Single Lip+Body	Multiple Lip and Body O-rings	Multiple Lip + Gaskets
<b>Total Emissions</b>	2500	2000	1200	700
Compressor	1	1		
	[place a "1" in the appropriate cell]			

# New System Rating

**3.7**

**% System Component Contribution**



# Benefits Of Reducing HFC-134a Leakage

- **Lower Direct GHG Emissions**
- **Less Maintenance and Cost**
- **Improved Compressor Reliability**

**Demonstrates HFC-134a Competitive In Climate Protection**

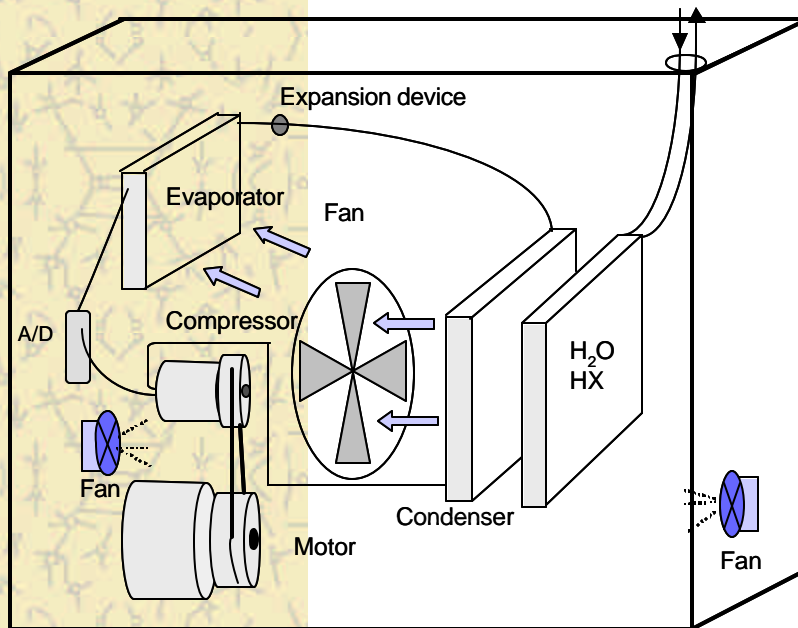
# **New SAE Design Documents**

## **HFC-134a SAE I-MAC CRP**

- **System Charging and Recovery Procedure**
  - **Field-Test Verification**
    - **Annual System Refrigerant Emission Protocol**
- **Mini-shed Total System Emission Protocol**
  - **Test Method Measurement For Component and System Leakage**
- **Test Method for A/C System Energy Consumption and COP**

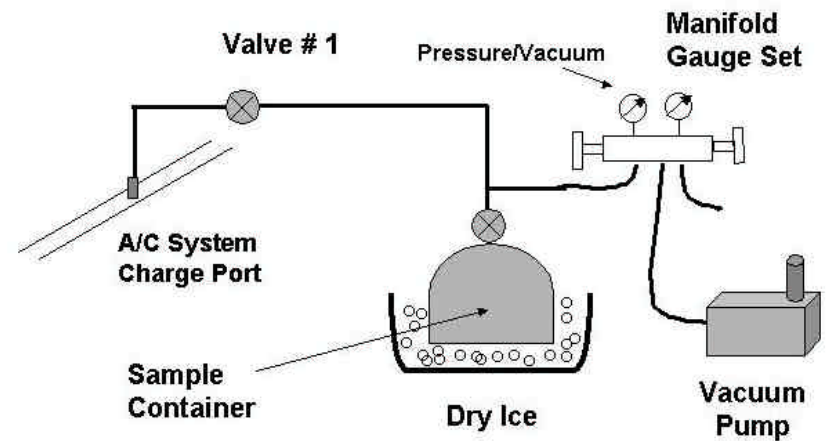
# SAE HFC-134a Verification

## System Mi-Shed



## Refrigerant Recovery

### Cold Bottle Refrigerant Sampling Method





# **HFC-134a I-MAC Service Goals**

- **Improved refrigerant containment at service**
  - **Revised technician procedures and recovery equipment requirements**
  - **New standard for refrigerant charging equipment**
  - **Improved leak detection equipment**

# **Other New SAE Design Documents**

- **Vehicle Interior Air Quality**
  - **Management of Outside/Recirculation System Airflow**
- **Balance Energy Reduction vs. Cabin Air Quality**



# **Use And Handling New Refrigerants**

**HFC152a**

**R744 Carbon Dioxide**

# System Design Goals

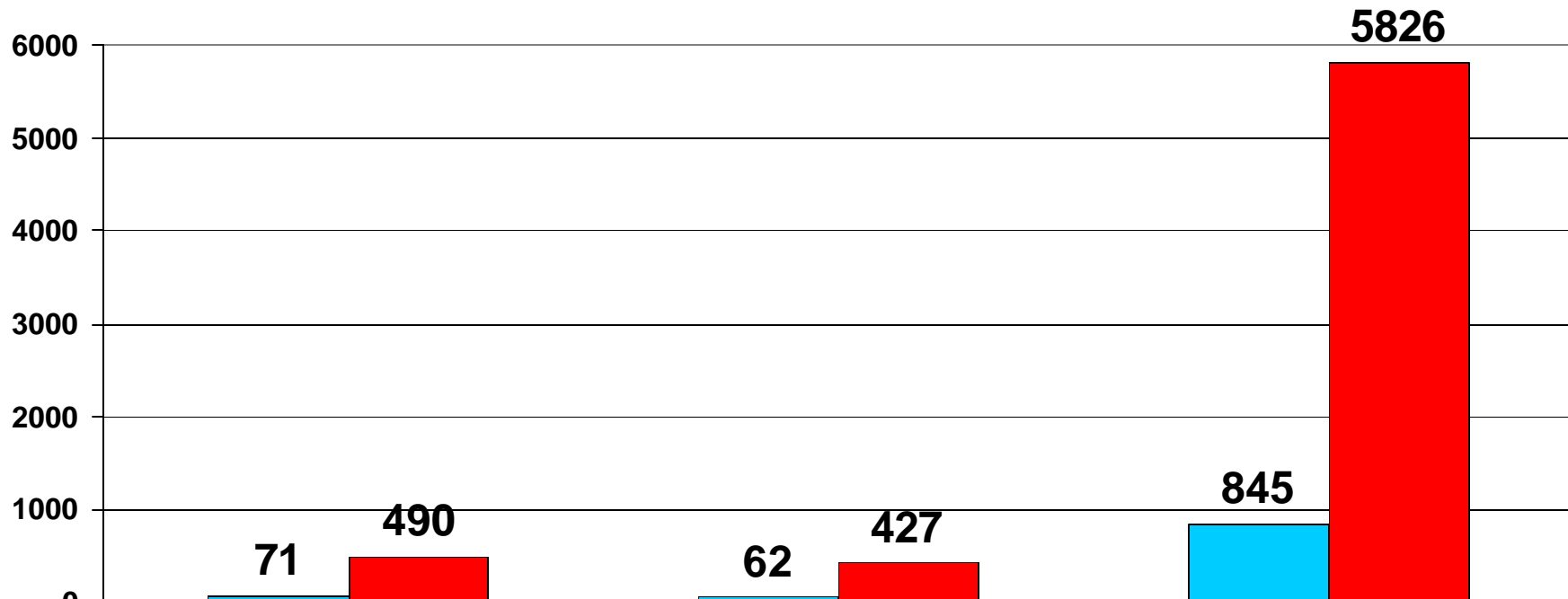
- **Current R134a Systems Provide 4-7 Years Of Operation Before Requiring Refrigerant Recharging**
  - I-MAC will demonstrate systems with 8-12 years of life
  - R152a systems will benefit from this work
- **New Refrigerant Systems Must Provide Improved Operational Service Life**
  - VDA Working Group At Phoenix 2003 Meeting Stated Goal For R744 Systems
    - “This means at least 5 years maintenance free operation in Phoenix.”

# MSDS Requirements For Handling Refrigerants

- **Considerations for developing new SAE J-standards**
  - **MSDS Requirements For HFC-152a and R744 Have Requirements For Container:**
    - Handling and movement in work area
    - On site storage
  - **R744 due to high pressure has additional handling safety issues**
  - **R152a due to flammability has additional handling safety issues**

# Refrigerant Tank Pressure

Pressure at 70F (21C)



PSIG

71

62

845

kPa

490

427

5826



# Refrigerant Handling

- **R744 Tank Pressure**
  - **12 Times Higher Pressure Than R134a**
  - **Proper Cylinder Movement & Storage**
  - **In US Japan Europe**  
**HAZARDOUS MATERIAL**  
**High Pressure Gas**





# **Required New R744 and HFC-152a Standards**

- **New Standards for System Refrigerant Connections**
  - **Refrigerant Tube/pipe Connections**
    - Fittings/joints
    - New standards required for R134a
- **Service Equipment and Technician Standards**
- **Refrigerant Leak Detection**

# New SAE R744 Documents

- **Need To Establish Requirement For Safe charging of the A/C system**
  - **Liquid State or Vapor State**
  - **Do containers require liquid pick up tubes?**
    - **Not currently standard**
  - **Safe Container Size/Amount**
  - **Concern for Safety when Transferring Between Containers**
  - **Requirement For Pressure Regulator**
  - **Pressure Relief Devices – Number - Shielding**

# CO<sub>2</sub> Material Compatibility

Aluminum	A
Brass	A
Monel	A
Copper	A
Carbon Steel	A
316 Stainless Steel	A
Buna-n	C
Butyl	D
Kel-F	A
Neoprene	B
Nylon	D
Polycarbonate	A
Polyethylene	B
PVC	A
Teflon	A
Viton	A

**Materials Currently Used in  
Systems and Service Equipment**

Legend	
A	Good
B	Fair
C	Poor
D	Insufficient Data

**New Material Standards  
Required For Service Equipment**



# **Japan Strategy towards Exemption of the High Pressure Gas Safety Law**

# Servicing Infrastructure: Japan

High pressure gas safety:  
Registration required for stockpiling of CO2 gas cylinder, charging and sales etc.

Documents should be sent to  
self-government office

Dealer

Charging and  
selling

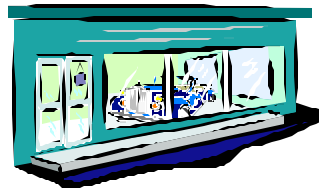


Recycling of CO2  
cylinder

**Regular inspection  
(1times/5yrs by  
KHK)**



**Stocks of  
CO2 cylinder**



CO2 Gas Maker (ex. Showa-  
tansan)



Chemical plant

Reclaiming

Compression

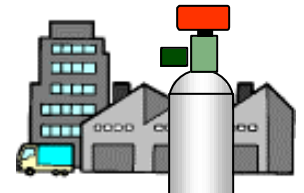
Recovery

Charging



**Distribution of  
CO2 cylinder**

Refrigerant Vessel maker

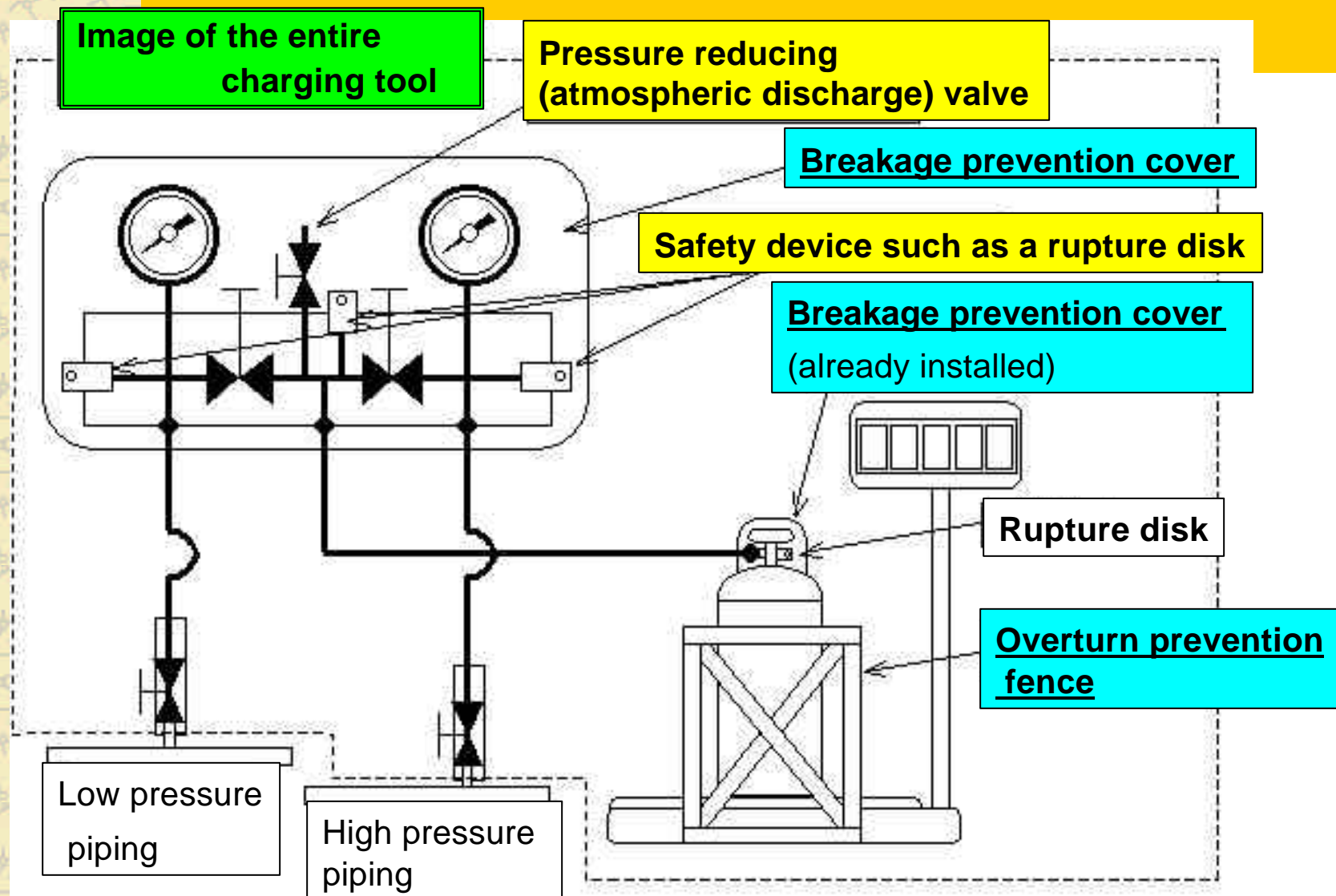


**Certification of  
cylinder by  
KHK**

**Restrictions of "HIGH PRESSURE GAS SAFETY LAW"** KHK: Certification agent in Japan



# CO<sub>2</sub> Charging Tool (JAMA)



# Industry Goals For All Refrigerants

- **Safety Issues**
  - For Vehicle Manufacturing
  - For Vehicle Service Sector
- **Extensive New Technician Training Certification Programs Required**
- **New Service Equipment Required**

**Many New Challenges For The MAC Industry !!!**